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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication in the Steel Industry

Rolling and Shaping

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

Looking Back—and Looking Forward

As you turn to the inside back cover ("the Recommendation Page"), you will find a recurrent mention of Texaco Crater Compound in various grades for various steel mill requirements.

This bears out the experience of many steel mill men.

And, some of them can look back with us to the time when they hoped that someone would discover a lubricant that would stand up under steel mill conditions, one that would adhere to the wearing surfaces of heavy rolling-mill gears, that would resist pressure, dirt, scale, steam, moisture and shock.

Meeting a Real Need

And we met that need when we developed the original Texaco Crater Compound. Almost overnight our manufacturing capacity was strained to meet the demand that followed the introduction of this product.

Then we increased our facilities; and Texaco Crater Compound is today a familiar name in the steel world. Texaco Crater Compound won instantly on its merits, and it is making new friends daily, and all the more because since that time a closer study has enabled us to make several grades for specific purposes. Thus, Texaco Crater Compound Nos. 1, 2 and 5 represent a range of heavy-bodied lubricants covering conditions varying from cable lubrication to that on the largest, roughest gears operating close to radiated heat.

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Later our laboratories produced and our engineers proved out the extreme value of Texaco Crater Compound X and XX where water conditions were so abnormal as to render inefficient all lubricants hitherto used at such places.

In Every Department

These five grades of lubricant enable us to give satisfaction in every department of the steel industry.

One thing all grades of Texaco Crater Compound have in common, and that is they "stay put;"—they will not fling off, spatter or squeeze out.

Many Uses

Their adhesion to metal surfaces, their resistance to pressure, their great lubricating value, and the sufficient diversity of grades of Texaco Crater Compound enable us to cooperate with users of heavy equipment such as gear trains in steel mills, sugar mills, on steam shovels and dredges, in mines of all types; on wire ropes and cables; on trolley gears, deck machinery, and wherever a heavy lubricant for rugged surface is required.

Prove It to Your Own Satisfaction

If you are in charge of any such machinery and know Texaco Crater Compound you will substantiate this. If you haven't yet tried Texaco Crater Compound do it soon—and you can look forward to a lubrication, and preservation efficiency that will surprise and please you. And we shall look forward to the beginning of a long period of very pleasant and satisfactory relations.

There is a Texaco Lubricant for every purpose

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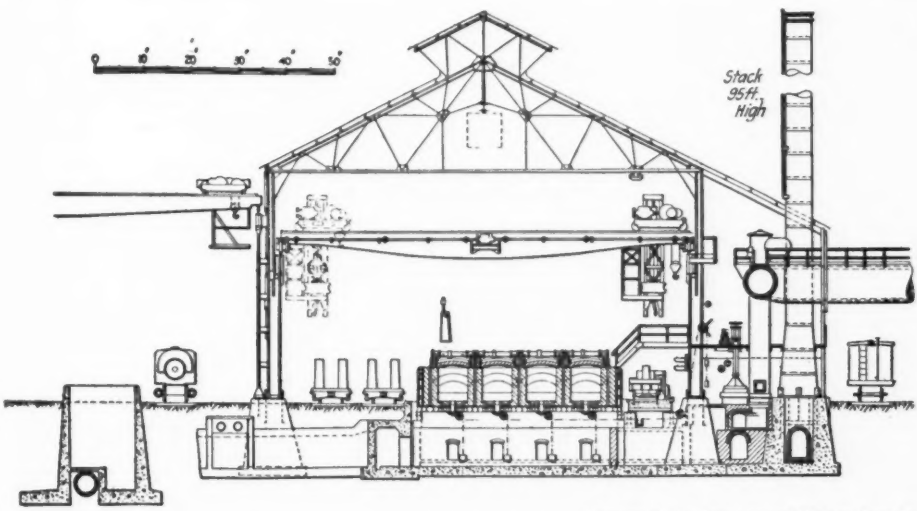


Courtesy of The Iron Age and Weirton Steel Co.

Fig. 1.—Sectional view of a soaking pit furnace building showing ingots fresh from the stripper on cars at the left, and an ingot on a buggy at the right of the four pits.

Lubrication in the Steel Industry

Rolling and Shaping

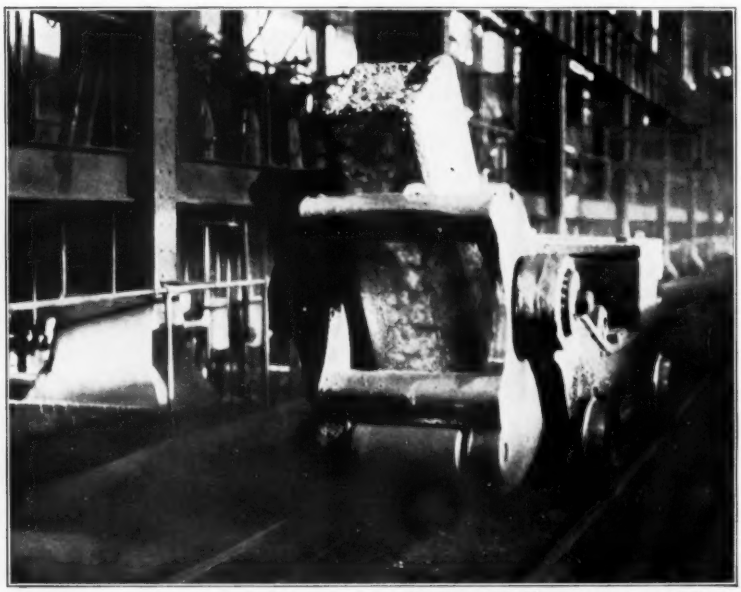
THE extent to which lubrication enters into the smelting and refining of iron was discussed in detail in the May 1924 issue of LUBRICATION. Herein we spoke of the treatment to which iron ore and the resultant pig iron is usually subjected in its conversion into steel and preparation for rolling. Furthermore, the intensive service to which practically all lubricants are put in the lubrication of blast furnace, converter, and open hearth equipment, etc., was studied in order to bring out the evident necessity for the exercising of the utmost care in the selection of the former.

THE SOAKING PITS

To this point, however, we have been dealing chiefly with iron. The actual fabrication of steel into workable shapes is a story in itself commencing in fact, with the passage of the red hot ingot through the blooming mill. There is one intermediate treatment

or process, however, to which the ingot must be subjected before it can be rolled, i. e., re-heating or soaking. Steel as it is poured from the Bessemer converter, open hearth or electric furnace, and cast into ingots, must be cooled for stripping or removal from the ingot moulds. Even and temperate cooling is very necessary in order to insure uniformity in the metallic structure throughout the ingot. The presence of cavities or blow-holes, due to certain of the contained gases being unable to escape, will render an ingot absolutely unsuitable for rolling, since the resultant shapes will be faulty in structure and composition.

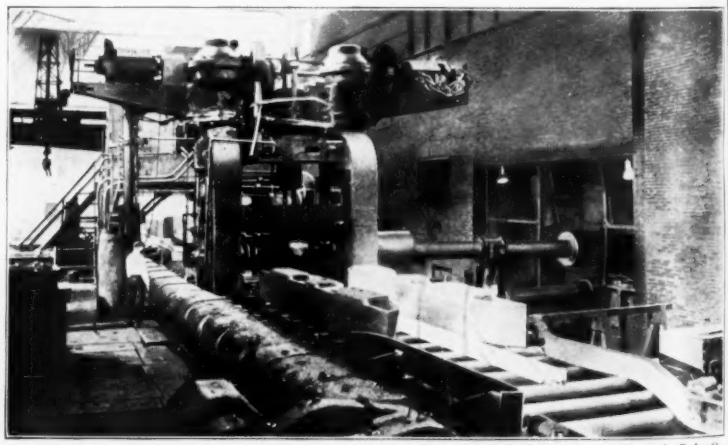
This cooling, is, however, only a temporary matter. In fact, it could more correctly be referred to as the process of solidification. After it has taken place, the ingot must be again heated to redness, for the rolling mill functions at its best in the breaking down of ingots into bars, billets, slabs and shapes when the former are in the workable state of red heat. So the solidified, and perhaps cooled, ingots are re-heated in gas fired ovens or soaking pits in order to bring them to an even temperature throughout. The length of time an ingot must remain in the soaking pit will vary with its temperature at the time of insertion. If, for example, ingots are charged directly from the strippers from one to two hours will be necessary according to their size. In this case, they will have scarcely passed from a red hot condition, their interiors being relatively plastic though not actually molten. On the other hand, when charging cold ingots considerably more time will be necessary to insure the proper heating.



Courtesy of The Youngstown Sheet & Tube Co.

Fig. 2.—View of an ingot buggy with an ingot ready for the blooming mill. Note the massive construction throughout.

Following this soaking or re-heating, they are then ready for preliminary rolling or breaking down in the blooming mill. An overhead electric crane is used to handle them to and from the pits and to place them on the ingot buggy which carries them to the approach table of the mill. This buggy is simply a heavy car running on a track between the soaking pits and the blooming mill; it is usually manipulated by a wire rope. The name is oftentimes a misnomer to the layman who may chance to confuse it with the more usually infantile or horse-drawn vehicle with which he is more familiar.



Courtesy of the Youngstown Sheet & Tube Co.

Fig. 3.—Close up view of a blooming mill showing details of construction and the proximity of the wearing parts to the red hot steel.

Soaking pits open at the top, being equipped with horizontal sliding covers or doors oper-

ated by hydraulic pressure. Ingots are usually handled to and from the soaking pits by means of specially constructed overhead traveling cranes. These are equipped with a peculiar form of nipper grip which is capable of holding an ingot rigidly and without danger of dropping it. This grip is operated by toggle joints. Due to the fact that this entire part of the mechanism must be lowered into the intense heat of the pit, every time an ingot is to be inserted or removed, it involves one of the most serious heat conditions which the lubricating engineer is called upon to meet. When the nipper takes hold of an ingot, which is ready for rolling, the temperature of the latter is in the neighborhood of 2000 deg. F. The toggle mechanisms are naturally subjected to perhaps even higher temperatures than this though fortunately they do not have to remain in the pit for any extensive period. Their lubrication is nevertheless, a most difficult problem. Oftentimes, it is met by application of an excess of the cheapest lubricant available—black oil; in other cases, a fairly heavy grade of more adhesive, heat resisting gear compound is preferred, especially as the temperature involved keeps this product sufficiently liquid to lubricate and yet does not cause it to drip off prematurely. Elsewhere, lubrication is confined solely to the necessary bearings, etc., with which the covers are fitted. The heat and operating conditions are akin to those in the open hearth furnace, therefore, black oil and a heavy gear compound are generally used with perhaps a graphite grease for the hydraulic plungers.

Courtesy of The Youngstown Sheet & Tube Co.

Fig. 5.—In the plate mill salt, heat and steam all ally to impair lubrication. Here a plate is shown in passage through the mill. Note the exposed journal ends on the table rolls.

Courtesy of The Youngstown Sheet & Tube Co.

Fig. 4.—A skelp mill wherein steel is rolled out preliminary to bending and welding into pipe. In this mill the dividing unit is often located adjacent to the rolls, its wearing parts being subject to considerable dust and dirt, hence its lubrication is important.

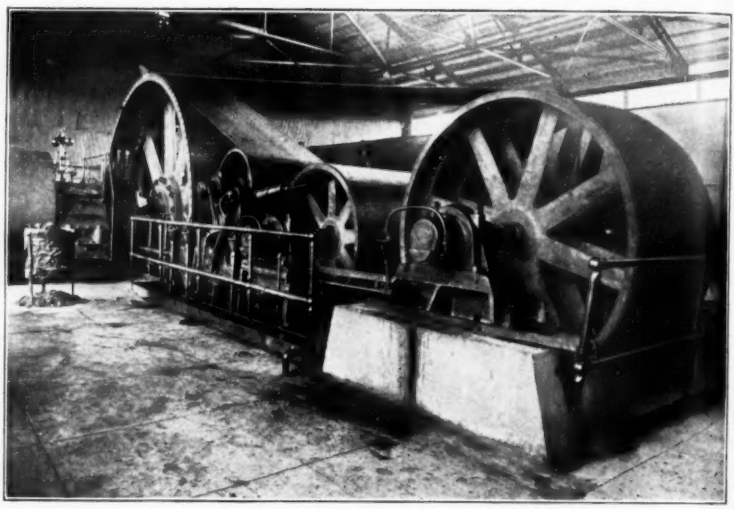
Ingot buggy lubrication is also a very similar proposition, though it involves the added item of wire rope lubrication. This can, however, be adequately taken care of by careful and frequent application of the usual gear lubricant at hand. While lubrication of these buggies may often seem to be but a trifling matter as compared with other more important equipment, it should, however, never be neglected, for a five-ton, red hot ingot is certainly not conducive to the most favorable pressure and temperature conditions. As a result, the bearings and other wearing parts may suffer considerably.

ROLLING MILLS

From the viewpoint of lubrication, conditions in the Rolling Mill are quite different from those discussed heretofore. In fact, lubrication of blooming mill gears, roll necks and steam engine cylinders involve probably more difficulties than any other phase of industrial plant operation.

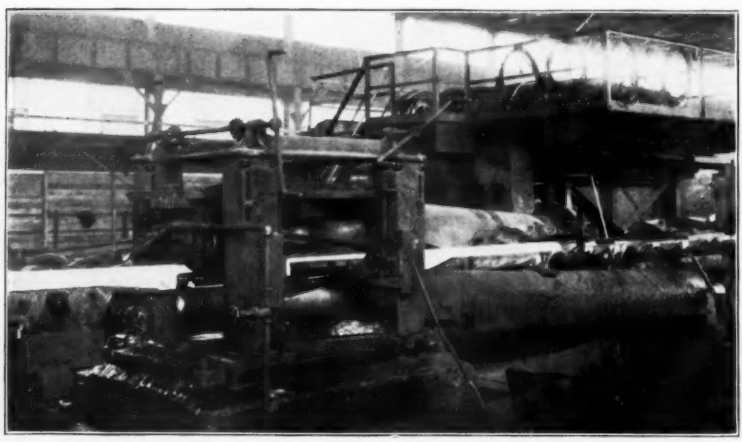
The blooming mill involves the first of a number of rolling processes, in the production of the multitude of shapes required by the construction engineer and machine builder.

When the ingot has been delivered to the ingot buggy and carried to the approach table of the blooming mill, it is automatically transferred to the rolls of the table. The approach table carries the ingot to the roll table; the latter working in conjunction with the rolls of the blooming mill. This mill consists essentially of two or three heavy cast steel rolls, gear-connected to a reversible steam engine or electric motor. The power rating of the driving element must be high, in extreme cases 35,000 to 42,000 horsepower being necessary.



Courtesy of Morgan Construction Co.

Fig. 7.—A merchant mill drive equipped with special ball and socket pulley shaft bearings. These require careful attention to lubrication.



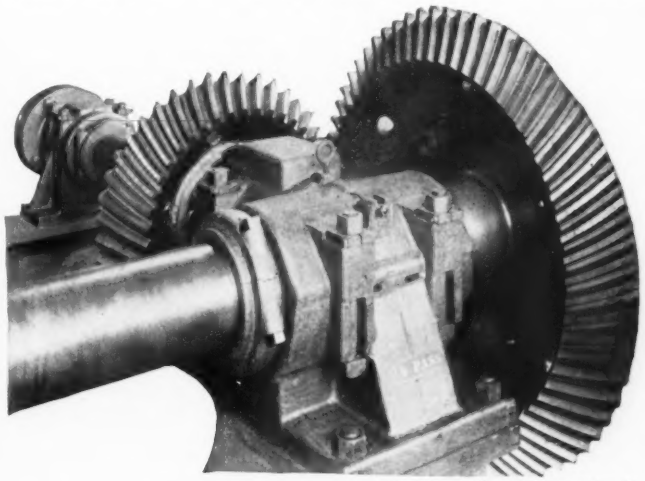
Courtesy of The Youngstown Sheet & Tube Co.

Fig. 6.—Here a steel tube is shown in process of formation by passage through the cross rolls of a tube mill. Roll necks on this machine are relatively close to hot steel, therefore their lubrication must be given careful attention.

In the 2-high (or two-roll) mill, the ingot is rolled backward and forward between one set of rolls, being squeezed down to the desired dimensions and also being greatly drawn out in length. The resultant product is called a slab or bloom according to the shape to which it is finally rolled. While the usual blooming mill will consist of but two rolls, it is not at all uncommon for this machine to be built with three rolls. In this case, arrangement must be made whereby the steel can be passed back and forth through first the lower and then the upper set, without the necessity of changing their direction of rotation. In the 3-high mill, as it is known, the ingot begins its passage by being run between the lower and middle rolls. It is then lifted automatically to the top level and passed back in the opposite direction between the top and middle rolls. At the end of its travel it is lowered for rolling again, in the original direction between the lower and middle rolls. The number of such alternate passes will depend entirely upon the extent to which the ingot is reduced at each rolling. Usually perhaps seven or nine passes will be required to transform an ingot into slab or billet form. The 3-high blooming mill will naturally involve a greater initial installation expense; on the other hand there is con-

siderable advantage pertaining due to the fact that speed of production can be materially increased.

When these shapes leave the blooming mill tables they are carried by other gear driven table rollers to suitable steam or hydraulic shears which crop the butt ends and cut the remaining sections into a number of shorter lengths for further rolling and reduction in one or more of the several other mills, according to the final shape and size of the resultant product. The butt ends must be cropped as they are usually unfit for rolling to final shape; after cropping they are removed by a conveyor or cars and taken back to the open hearth plant as scrap. Billets in turn are carried by discharge table rollers to the approach table of the next set of rolling mills. In other words, whatever the nature of the final product, the steel rolling mill will involve much the same equipment, and the process will constitute a series of rollings, croppings or shearings, coolings and usually reheatings. Skelp, for example, will require reheating before it can be bent and welded into pipe. The same holds true in sheet steel rolling. Some shapes, however, go through the bloomer and continuous mill under but one heat.



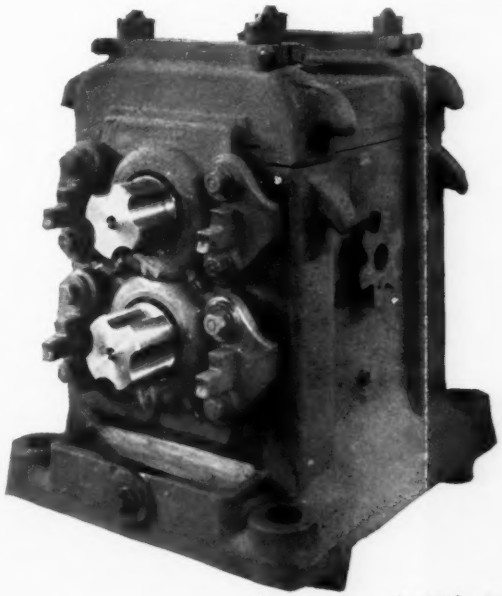
Courtesy of Morgan Construction Co.

Fig. 8.—Close up view of a mill drive Tee bearing showing the gearing involved. These are built for especially heavy duty and the lubrication of both bearing and gears must be given careful attention.

As a rule, the finishing mills are termed continuous in that they operate in the same direction all the while. In effect they embody the necessary finishing stages wherein rails, plates, strips and structural shapes are produced. A typical arrangement comprises three stands of rolls, similar to the 3-high blooming mill. Two of these rolls turn one way, the other set rolling in the opposite direction. In such a mill the billet is directed by guides through the proper passes in the first and third stands. It is then elevated automatically and dropped into other guides which direct it back through the second set of rolls. The construction of these guides is unusual and their type of service is severe for, of course, they come in direct contact with the hot metal. In order to enable the latter to slide easily and rapidly over them, they should be painted with some lubricant which will stick despite the heat, and not gum or dry up. For this purpose a mineral gear compound of from 2,000 to 5,000 seconds Saybolt at 210° F. has been found to be effective in many mills.

LUBRICATION

The rolling mill, therefore, involves a certain number of rolls, shears, saws, transfer tables, electric cranes and driving units. In their operation, gears, roll neck and journal bearings, steam cylinders and miscellaneous guide and shaft bearings constitute the usual frictional elements. In the blooming mill, for example, the most important parts requiring efficient lubrication are the pinions and gears, roll necks and electric or hydraulic screw-downs for adjusting the rolls.



Courtesy of Morgan Construction Co.

Fig. 9.—A type of enclosed pinion housing in which both the bearings and pinion teeth are automatically lubricated. In some mills two grades of oil are used in this housing, for the bearings and gears, respectively. Others use the same product selecting it of such characteristics that it will meet the essential requirements of each.

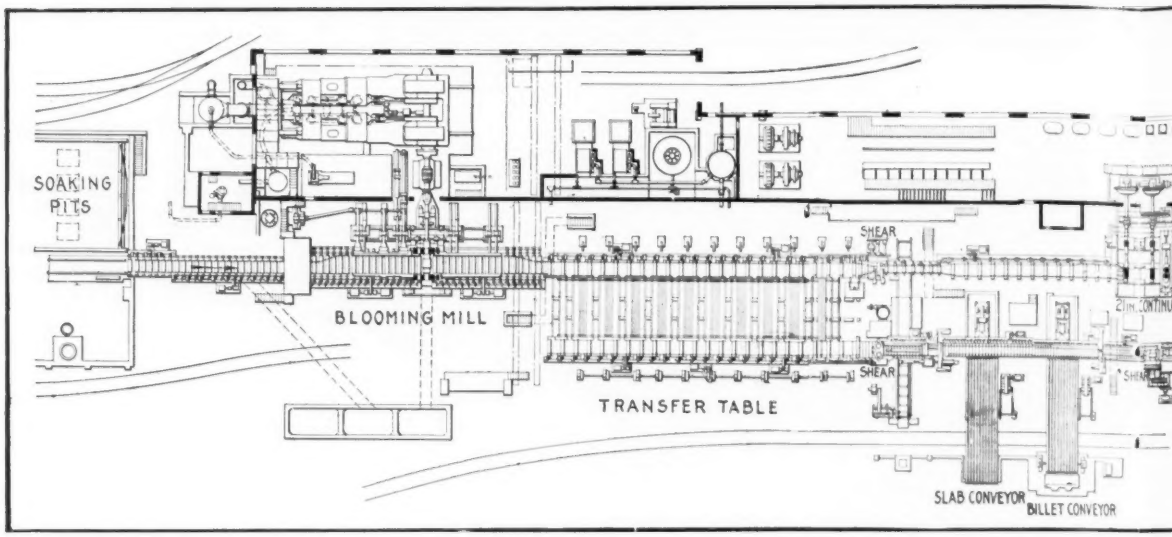
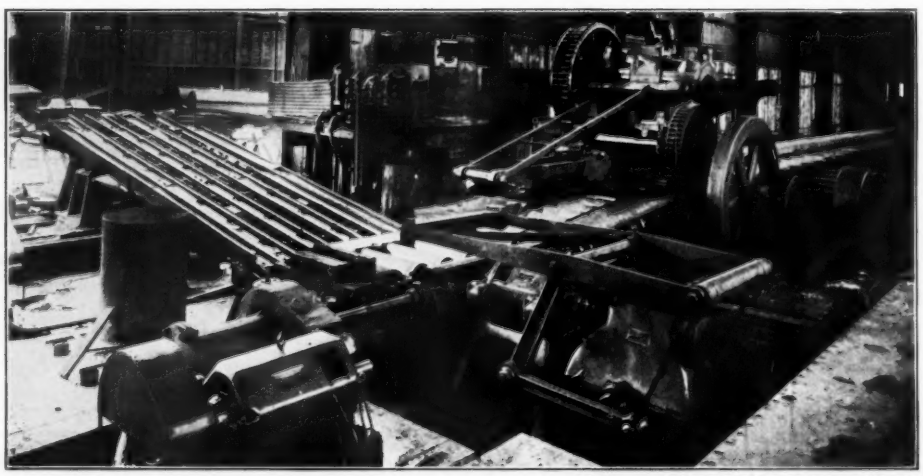


Fig. 10.—Line sketch of a modern steel rolling mill showing the v

Gears and Pinions

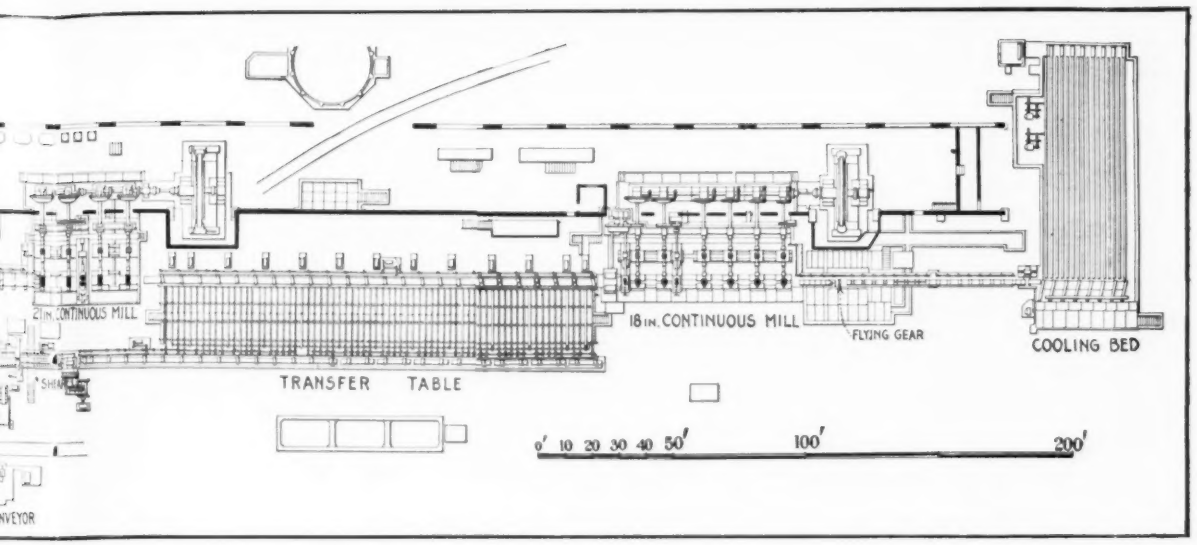
The pinions adjacent to the roll necks in the blooming mill are usually enclosed in an oil-tight casing in which event they are run in a bath of specially prepared gear compound of high adhesive characteristics having a viscosity of about 2000 seconds Saybolt at 210° F. On the other hand, in some installations these pinions may be only covered with shields which are not oil tight. Where this is done there is often no bottom to the gear case, therefore, bath lubrication is out of the question. Hence the lubricant must be able to stick tenaciously to the pinions over the periods which intervene between its application, and maintain a sufficiently protective film. A viscosity of about 5000 seconds Saybolt at 210 deg. F. is, therefore, necessary in order that the resultant lubricating film will be able to withstand the terrific pounding and hammering which occurs especially whenever the mill is reversed.

Not only in the blooming mill but on all other rolls except in the plate and sheet mills, it is found necessary to run water constantly over the rolls and roll necks for the dual purpose of cooling and blowing off scale which may be formed as the ingots, bars or billets are broken down. Some mills, in addition, blow steam directly onto the ingot during its



Courtesy of United Engineering & Foundry Co.

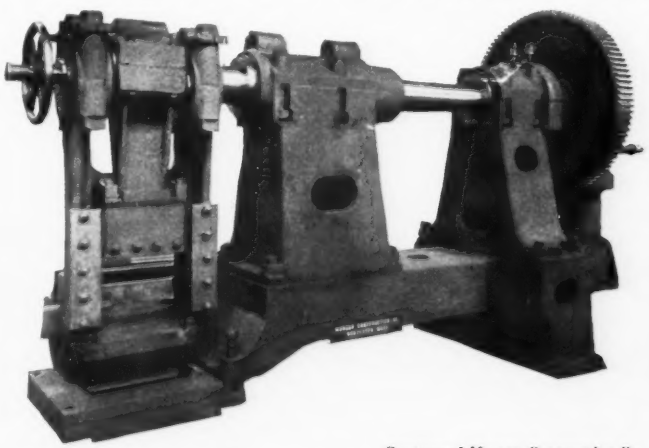
Fig. 11.—Assembled view of a set of bloom shearing apparatus. Note the proximity of the electric motors to the table and shear, and the exposed gearing. Another place where careful lubrication is necessary.



showing the various units involved and their relation to one another.

Courtesy of The Iron Age & Wierton Steel Co.

first pass through the rolls in order to more effectively remove the scale. Such conditions coupled with the extreme heat which is constantly encountered, places a most exacting requirement upon both the roll neck and gear lubricants. These must, therefore, be compounded products, inasmuch as straight mineral lubricants will not withstand the continued washing action of hot water. The usual procedure is to compound the gear lubricant with definite percentages of certain substances which will give the final product the desired adhesive properties. Any rolling mill gearing, however, which does not come in contact with water can readily be lubricated with a straight mineral gear compound of a viscosity ranging from 2000 to 5000 seconds Saybolt according to temperature conditions and the manner of lubrication.



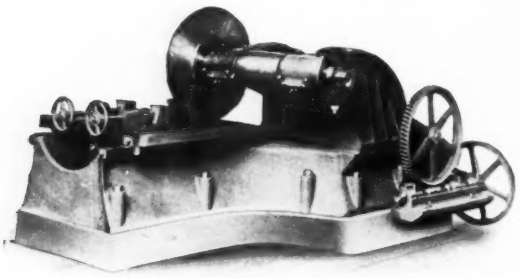
Courtesy of Morgan Construction Co.

Fig. 12.—A type of up and down cut shears together with the driving unit. This machine is equipped with special crank shaft bearings which require very careful lubrication.

The rolls of continuous mills in turn are usually driven by herringbone pinions, and a set of relatively heavy gears. These pinions in a mill as described above are often so constructed as to make it necessary to lubricate the bearings with grease, and to maintain a continuous flow of cooling water over them. Naturally this water will splash onto the pinions (where exposed), involving a condition and requiring a grade of lubricant as has been mentioned above in discussing the blooming mill. Certain mills, however, may be built with oil tight gear cases and suitable shields which will permit of bath lubrication. This, of course, is the admirable condition, for the utmost of protection is afforded both the lubricant and the gear teeth.

According to the type of steel which is to be produced, it may be necessary to pass the resultant billets through another continuous mill which is set for further reductions in the size of the bars. In construction, operation and lubricating requirements, it will usually be much similar to the one already discussed. The semi-finished product is then ready for delivery to the various finishing rolls. These latter are capable of turning out an extensive variety of rounds, squares, flats and structural

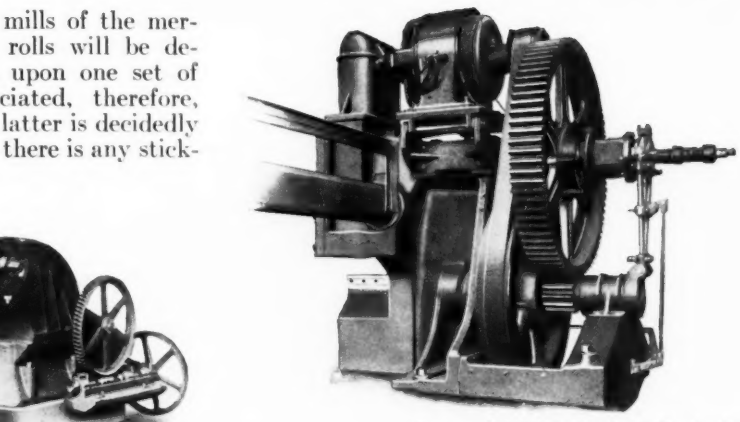
shapes. In certain of such mills of the merchant type, several sets of rolls will be dependent for their operation upon one set of pinions. It can be appreciated, therefore, that the lubrication of these latter is decidedly important. For example, if there is any sticking, catching or chattering in the pinions, or if they mesh improperly or the points ride, by the time motion has been transmitted to the end rolls any faulty operation will have become considerably exaggerated. Lost motion, in fact, may develop to such an extent as to markedly interfere with the finishing of the product. Where the final finishing rolls operate as individual units, this danger will, of course, be greatly reduced, although it should always be considered when selecting pinion lubricants. For this class of service the lubricant must be of relatively high viscosity and extremely adhesive, for water and heat conditions are usually quite as severe as elsewhere in the plant.



Courtesy of United Engineering & Foundry Co.

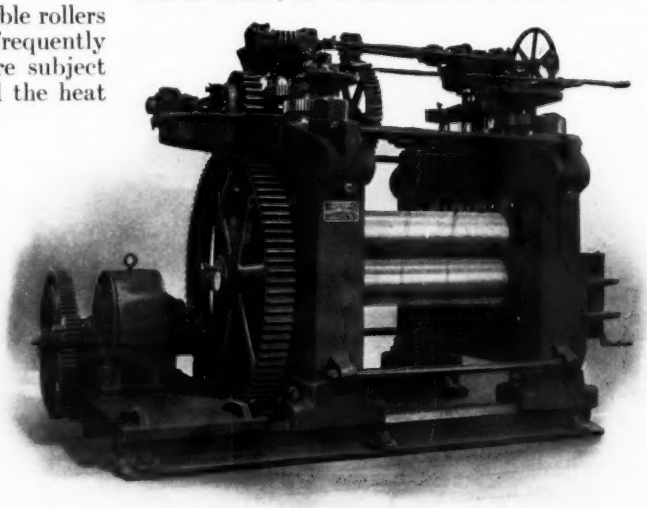
Fig. 13.—A sliding table saw equipped with an electric feed. This is an economical machine to operate from a power consumption view-point.

The bevel gears which drive the table rollers nearest to any type of rolling mill, frequently operate exposed. They are therefore subject to water conditions, flying scale and the heat which radiates from the hot metal in its course through the plant. Here the gear lubricant is difficult to apply, in the first place, and furthermore, after it has been applied there is every obstacle put in the way of its functioning effectively. Centrifugal force will tend to throw it off, especially where it has suffered any extensive reduction in viscosity, due to over-heating. The washing action of the water which splashes over such gears is also a detriment. In addition, excessive contamination by solid foreign matter can hardly be avoided, unless precaution is taken to effectively guard such gears. Ultimate protection can only be attained, therefore, by frequent applications of a lubricant which has been so refined as to withstand these detrimental conditions. Usually the same product as recommended for the blooming mill gears must be used, having a viscosity of from 1000 to 2000 seconds Saybolt at 210° F., according to weather and temperature conditions involved. It should be applied by pouring onto the teeth at the point of mesh while the gears are running inward. The frequency of application will of course depend upon the amount of steel rolled through the mill and the intensity of operation. In general, over-lubrication leads but to waste, for a uniform film which covers



Courtesy of United Engineering & Foundry Co.

Fig. 14.—A vertical open side shear having a maximum stroke of "6." This shear is designed for cold cutting though it can be applied to hot cutting as well. Note the massive construction of the gears. On this machine periodic shocks must be borne by both gear and bearing lubricants, which will tend to break the lubricating film. These products must, therefore, be carefully selected and judiciously applied

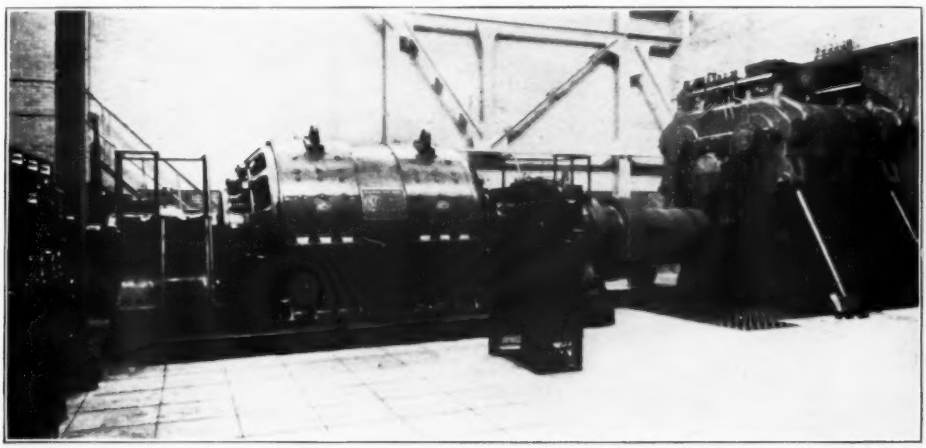


Courtesy of United Engineering & Foundry Co.

Fig. 15.—A type of plate leveler used in conjunction with the plate mill. The variety of exposed gearing involved is of special interest.

he entire wearing surfaces is all that is necesary for their adequate protection. The applitation of any excess lubricant will simply mean hat it will be squeezed out and probably hrown from the teeth in a short time.

Plate mills present an additional detrimental ondition due to the quantities of salt which re thrown on the plates during the process of olling, and also the fact that the red hot lates pass directly over the bearings and gears f the table rollers. The purpose of salting is o remove the scale. Oftentimes, water is also prayed on the rolls in addition. These facors, coupled with flying scale and dust which s driven with considerable force when the hot ases explode, tend to destroy any lubricant sed on the roll necks, table roller bearings and ears. Types of mineral gear compounds as pecified above have been found to withstand nese detrimental elements quite satisfactorily



Courtesy of The Youngstown Sheet & Tube Co.

Fig. 16.—A skelp mill drive wherein electric power is used instead of steam.

provided they are applied at frequent interals and in sufficient quantities.

Plate mills may be either of the two-high or hree-high type, being driven by a correponding set of herring-bone pinions. In many ases these driving pinions will be located in pen housings, so adjacent to the mills that t is relatively impossible to protect them in ny other way than by means of effective ubrication. Here an additional property hich the gear lubricant must possess is an bility to resist being thinned out by the oil hich is used on the pinion bearings, inasmuch s a good deal of this latter will often work ut and onto the gear teeth, especially in older ypes of mills.

Necks.

oll necks must be lubricated with a spelly compounded roll neck grease that will not carbonize nor wash off when in contact with the water which is so often run over them to keep them cool. Lubricants used on such roll necks are termed cold neck greases. In general, they are tallow-mineral oil compounds, oftentimes being so prepared as to emulsify on contact with water. Frequently however, water is not used or even where it is, the necks may run so hot as to melt down a cold neck grease. In such cases, a hot neck grease of high melting point must be substituted even though added friction and wear may be developed.

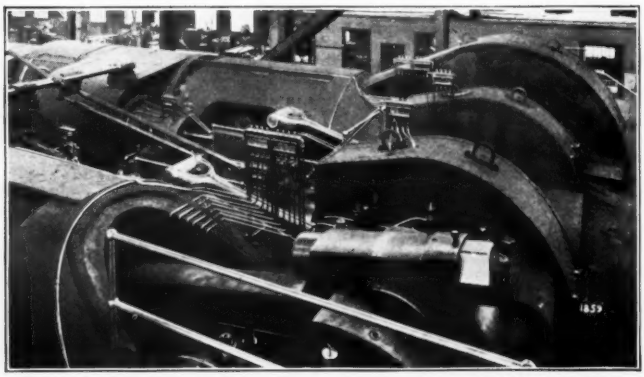
The Screw-Down.

As its name implies, this consists of two long screws driven by electric or hydraulic power; its purpose is to raise or lower the rolls as necessary. While it is not subject to water conditions, nevertheless it will also receive considerable heat and perhaps its share of flying scale and dust. Therefore, it too, requires careful lubrication. These screws should be lubricated periodically with a fairly heavy grade of straight mineral, steam refined cylinder oil of a viscosity sufficient to withstand the high pressures which are involved.

ACCESSORY EQUIPMENT

The lubricating requirements of accessory rolling mill equipment, such as saws, shears, electric cranes and cooling tables, etc., in most cases will vary but little from general roll lubrication. As a rule the same detrimental conditions which the working of hot steel involves are present, to reduce the effectiveness of lubrication. In other words heat, dust, dirt and high pressures must be combatted in practically all cases. Furthermore, certain types of high speed saws also must be provided

with cooling water. This is usually applied to the saw as it leaves the cut. Unless suitable precaution is taken to prevent undue splashing, this water will often become an additional detriment to lubrication.



Courtesy of Mesta Machine Co.

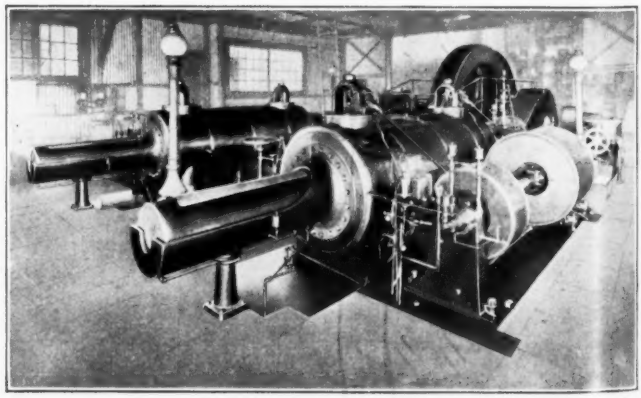
Fig. 17.—Crank end view of a una-flow type of steam engine used for the driving of a reversing blooming mill. The extensive lubricating equipment shown above the engine is of particular interest.

Saws are a factor of production in every steel plant where the smoothness of the finished material and the matter of waste or scrap are considered. In general saws can be adapted to either hot or cold cutting according to the nature of the specification. Motor drives are usual on such equipment, the feeding of material in turn being brought about by means of motors, hydraulic, steam or air pressure, or hand operation in certain smaller machines.

All this equipment requires a nicety of construction and a smoothness of operation; otherwise cutting will be materially affected. To bring this about, the builders have given careful attention to lubricating equipment; therefore, similar attention should be given by the steel man to the selection of the lubricants. While plain bearings and gearing will be chiefly involved, some high speed saws will be built with their arbors or main shafts mounted on ball bearings. Arbor bearings are subject to the brunt of the work, and friction must be reduced to a minimum, otherwise it will tend to become cumulative.

Whereas saws involve a considerably sustained pressure in their operation, shears are subjected more to extreme shock and enormous loads, pressure being a factor only after the blade has begun its cutting work. Such a condition naturally imposes a severe strain upon the lubricant used on the gear teeth. In this case its body or viscosity is the salient factor, although it should always be highly adhesive, for we must remember that its primary duty is to resist the squeezing out action which occurs periodically between the gear teeth. Double reduction gears are coming more and more into usage in shear construction. It is reasonable to presume that the shock is thereby minimized by being distributed over a greater number of gears during the period of operation. The motive power employed involves the electric motor to a large extent, though steam and hydraulic power are also used. For example, the steam hydraulic shear is especially adaptable for the cutting of blooms and slabs.

Other accessory equipment will involve conditions so akin to those already discussed heretofore that it is unnecessary to treat them in further detail. In general the same grades of lubricants can be used, viz: Black oils for rough bearing lubrication, straight mineral gear compounds of from 2000 to 5000 seconds viscosity Saybolt at 210° F. for gears and wire rope, a good grade of medium viscosity engine oil for motor bearings, and a graphite grease for the hydraulic plungers of manipulators, etc. These latter are the "fly-wheels" of an hydraulic system and serve to equalize pressure and store energy; therefore, they will always require careful attention.



Courtesy of Nordberg Manufacturing Co.

Fig. 18.—A duplex 28 x 42 uni-flow engine which is used for driving a sheet mill. Force feed lubrication is a feature on this engine, the necessary equipment thereto being clearly in evidence.

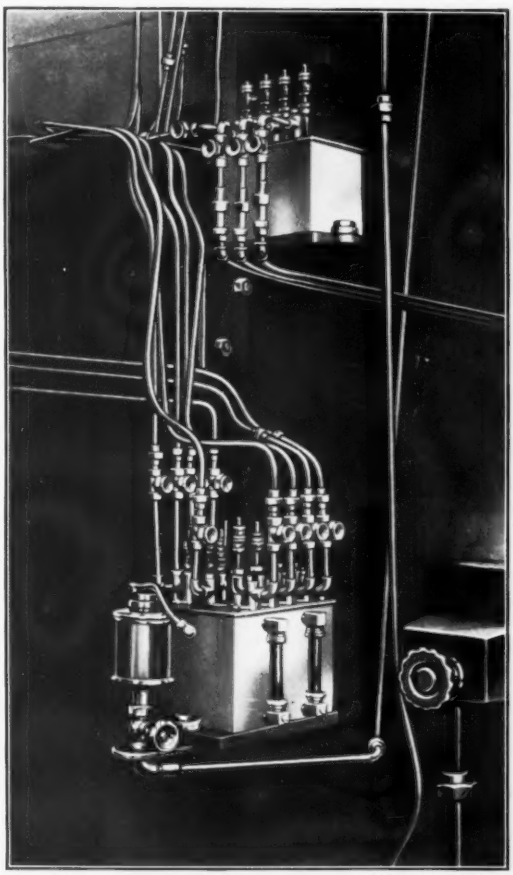
POWER EQUIPMENT

Essentially the power equipment which will be found necessary to the operation of the rolling mill includes electric motors and reciprocating steam engines of both the uniflow and counterflow types. Practice has been to limit the electric motor to the driving of such accessory equipment as shears, saws, tables and cranes; the steam engine being used heretofore as the prime mover on practically all roughing and finishing rolls. More recent developments in electric motor construction, however, have led to the perfection of a reversible machine which has been found readily adaptable to the driving of blooming mills in certain steel plants.

In general the blooming mill steam engine will present the chief lubricating problem due to its size, the differences in load which are prevalent, and the continual reversing to which it is usually subject. Dependent upon the distance of the engine from the boiler house, the extent to which the lines are covered and the weather conditions, the steam delivered to the engine will naturally vary in pressure and superheat. Therefore its quality or moisture content will often be changing constantly. Periodic starting, stopping and reversing also tends to increase the amount of actual moisture which passes through the cylinders, due to condensation. So the average blooming mill steam engine will operate on wet steam, oftentimes water conditions being so severe as to tend to wash the lubricant almost instantly from the cylinder walls. The extent to which moisture content and condensation may vary naturally precludes the selection of a grade of cylinder oil suitable for all conditions. Theoretically, its compound content should be high, but oftentimes, the possibility of returning oil back to the boilers makes it necessary to use a lubricant with as little animal compound as possible. So excess water conditions must often be met by an increase in the amount of oil fed to the engine cylinders. In fact this is one place where theoretical feeding of cylinder oil at a definite rate of a certain number of drops per minute, is often impracticable.

For steam cylinder lubrication in the steel mill, it is generally advisable, wherever possible, to select one grade of cylinder oil which will best meet all the varying conditions that may occur. The use of a number of different grades of oil would be theoretically better, of course, but would in turn often lead to confusion, especially in plants where oil house management might be lax, or where an ignorant type of labor must handle the lubricants. In other words, lubrication economy must be sacrificed to a certain extent in favor of general plant economy, and the necessity to keep running in a dependable manner. Use of excess lubricant in such cases is better than the attainment of theoretical maximum efficiency, otherwise it might develop into a case of "spare the lubricant and spoil the machine."

Lubrication of steam engine bearings must be considered from the viewpoint of the location and guarding of the engine. For example, where the prime mover is installed in a separate

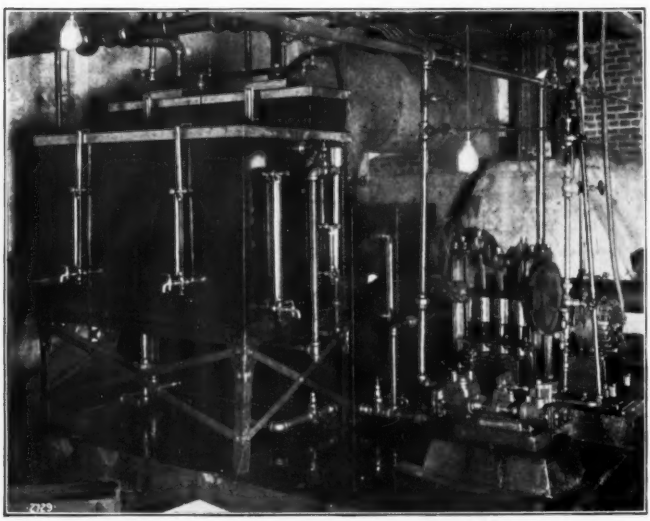


Courtesy of Hills-McCanna Co.

Fig. 19.—An installation of force feed lubricating equipment as applied to a steel plant blowing engine.

engine room naturally conditions will be cleaner and the oil will not pick up as much dirt as it would were the engine exposed to usual operating conditions in the Plant. Blooming mill engines in particular are often located in a room set aside for power plant equipment. Unless they are provided with guards, however, to prevent oil from being thrown from the crosshead guides and crank pins, economy and cleanliness cannot be maintained, and these engines will be relatively

no better off from a lubricating point of view, than the machine which is located adjacent to the rolling mill. The frequency with which blooming mill engines start, stop and reverse, and their high operating speeds cannot help but lead to excessive splashing and throwing of oil from practically all the external parts.



Courtesy of Mesta Machine Co.

Fig. 20.—A typical oil pump and filter tank installation used in connection with steel plant service. Purification of lubricating oils is a decidedly important feature in every phase of this industry, both from the view point of economy as well as efficiency.

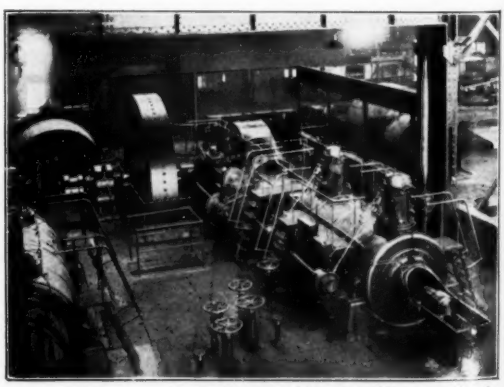
Oftentimes this oil is caught by suitable guards and returned to the system. Where it is deposited on the cylinder heads, however, it becomes a loss due to rapid vaporization.

Engines which are installed in the same building with the mill are naturally exposed to all the dirt, dust, particles of steel and scale which are so prevalent in such locations. Circulating oiling systems are the best protection for engine bearings under these conditions; essentially the problem is to maintain the oil in a suitable state of purity and as free from external contamination as possible. A suitable oil purifier must always, therefore, be a part of such an installation, for it is relatively impossible to prevent foreign matter from coming in contact with the oil especially on eccentrics, valve mechanisms and oftentimes the crossheads and crank pins. As a rule a highly refined straight mineral oil of from 200 to 300 seconds Saybolt at 100° F. will meet the requirement as a general rolling mill engine bearing lubricant.

The electric driven mill, of course, eliminates the matter of steam cylinder lubrication. Periodic reversal in this case has practically no more detrimental effect upon lubrication than in the steam engine. To be sure such bearings are large and heavy but so effectively have the principles of automatic lubrication been adapted that oiling troubles are a rarity. Elsewhere in the plant electric motors will usually be equipped for ring oiling. In either type of system, however, the usual engine oil as specified above for engine bearing lubrication will function perfectly satisfactorily.

CONCLUSION

In the steel plant, as elsewhere, there can be but one ultimate result of better lubrication, if it has been scientifically planned, i. e., increased efficiency. Increased efficiency constitutes essentially (a) an increase in production, and (b) a reduction in power consumption. Therefore better lubrication is advisable; to what extent, inference may be drawn from the statement of authorities that as high as 1½% increased production with approximately a 10% reduction in power consumption is obtainable. To reduce the benefits of scientific lubrication to a dollars and cents viewpoint is a most forcible way of driving home its advantages. To obtain these advantages it is but necessary to study plant machinery for the purpose of correcting, as far as possible, the more usual lubricating difficulties (as brought out above), which may be encountered, and to select lubricants to most effectively meet the operating conditions at hand.



Courtesy of Nordberg Manufacturing Co.

Fig. 21.—General view of a uni-flow engine installation in a rolling mill.

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